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Towards sustainable construction in Oman: Challenges & Opportunities

Mohamed S. Saleh*, C. Alalouch

Department of Civil & Architectural Engineering, College of Engineering, Sultan Qaboos University, P.O.33, Al-Khod, Muscat 123, Oman

Abstract

Over the past few decades, Oman is experiencing a rapid economic growth associated with the flourishing and maturity of the oil production. The construction sector has seen to be the primary beneficiary with the blooming of many new infrastructure projects that serves the rapid urban development. In line with the booming awareness of the sustainable development of its neighboring countries, many proactive actions from the government and professional bodies attempts to introduce the sustainability concept to the industry. However, the lack of evidence on sustainability progress suggests that these values are not yet at the top of the construction industry agenda.

This paper reviews the current application of sustainability in the construction industry in Oman. Informative challenges and opportunities have been identified through market surveys and a qualitative observational research method of current eco-house construction project conducted by Sultan Qaboos University within a competition initiated by the research council in Oman. The proposed recommendations of this study shall help promoting and improving the sustainability application in the Omani construction practices in the future.

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Keywords: Sustainable construction, Construction industry, Oman

* Corresponding author. Tel.: +968 9208 3900.
E-mail address: msalah@squ.edu.om

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1. Introduction

The pursuit of sustainable development in many countries as an effort to enhance the environmental, social and economic aspects puts the build environment and the construction industry high in their agenda. Among other human activities such as industry, agriculture, and transportation, the building construction sector alone consumes around 40% of entire produced energy [39]. Therefore, sustainable construction has been seen as the response of the building construction sector to the challenge of sustainable development [17].

Over the past decade, the Middle East region has experienced a rapid booming in the construction sector associated with the flourishing and maturity of the oil production, which on the other hand raised the domestic levels of energy consumption per capita [5]. Therefore, these countries are considered among the highest contributor to the emission of CO_2 per capita [10]. However, countries of the Gulf Cooperation Council (GCC) have responded to this situation by giving high consideration on the environmental sustainability issues with special focus on energy efficiency, renewable energy and life cycle management of assets. Over the past few years, many of these countries have started to introduce green building codes to encourage the building industry to become more sustainable. For example, Abu Dhabi has launched its Estidama (sustainability) rating system, Dubai has introduced the Green Building Decree, and Qatar has established the Qatar Sustainability Assessment System (QSAS) which was developed specifically for Qatar [3].

The objectives of this paper are to overview and analyze the current opportunities and challenges in implementing sustainable construction practices in Oman. The paper presents recent market surveys and analyzing a case study of Eco-friendly construction project within Sultan Qaboos University. The aim of this research is to conclude a general classification for the critical challenges to the implementation of sustainable construction practices in Oman, and to propose initiatives to push forward these practices between different stakeholders of the construction industry.

2. Sustainability opportunities in Oman

Oman; as one of the GCC countries; has witnesses in the last few years a substantial growth in the construction industry associated with the flourishing of its economy and the rapid growth in population. According to the World Bank data, the Omani's economy faces a growth rate of 71% between 2006 and 2013, from almost $47bn in 2006 to $80.5bn in 2013. The country's population has been increased less dramatically in the same period from 3.1m in 2006 to 3.6m in 2013 with a growth rate of 16% [37].With a large segment of the population is young, the housing demand should heavily increase over the coming decade.

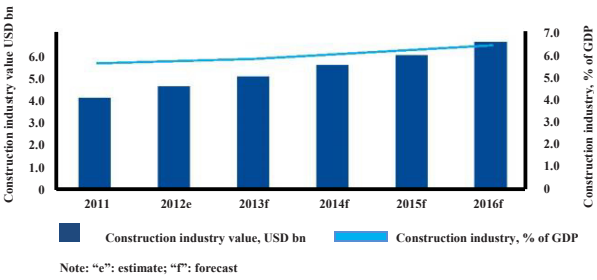

Figure 1 Construction value and growth in Oman [13].

Beside the residential development many construction projects in Muscat; the capital city; are focused on increasing the city's tourism appeal, other construction projects related to industrial and transport expansion are growing substantially in cities such as Sohar, Salalah and Duqm. While the urban development requires the construction of new road networks and upgrades to existing networks, other infrastructure projects involve the upgrading of seaports are also planned [15]. A number of construction projects in Oman are already working to implement sustainable building practices. Omran, a government-owned development, investment and asset Management Company focused on the tourism sector, is currently developing four such projects [35]. However, as the construction sector expands, challenges remain.

Bearing in Mind, that Oman oil and gas productions are generally lower than other GCC countries with higher production cost. Rapid economic and population growth are substantially increasing power and water demand. The government of Oman has decided to expand the sustainable construction practices aiming to reduce power and water needs while minimizing the environmental side effects of rapid construction growth. In addition, buildings constructed with ecology in mind bring benefits, including lower operating, development and maintenance costs, as well as improved durability [35].

The government has taken many proactive actions to encourage the development of sustainable construction practices in Oman. The Research Council (TRC), a local policy-making body and funding organization was set up in 2005. Tasked with the mission of increasing innovation in Oman, TRC is promoting green building research efforts by organizing the Oman Eco-House Design Competition, which is open to all higher education institutions in Oman. The competition is intended to do more than provide a challenging academic exercise. Indeed, TRC hopes the contest will lead to better policy-making and increase the country's capacity to develop sustainable buildings [36]. The push for sustainable building practices has been strengthened with efforts by The Oman Green Building Council (OGBC) which was set up in 2012 to study, promote and support the sultanate's nascent eco-construction movement. It has been actively promoting green concept through conferences and seminars. Builders' international gathering called as The BIG Show exhibition and The Oman Builders Forum is held annually [35].

3. Challenges in pursuing sustainable construction in Oman

Construction industry is considered as the broad process/mechanism for the creation and use of human settlements. This includes the whole project cycle from feasibility studies to deconstruction [34]. Kibert defined sustainable construction as "*the creation and responsible management of a healthy built environment based on resource efficient and ecological principles*" [21]. Agenda 21 for sustainable construction was established to set an international blueprint for the construction industry to set a specific sustainability agenda [34]. According to Agenda 21, three main dimensions were identified for sustainable construction, which are environmental, social and economic concerns which differ from the traditional perspective, where the concerns were utility, durability and economy [8].

Many recent studies addressed potential challenges to the implementation of sustainable construction in different countries and regions. Hill & Bowen proposed the four pillars of sustainable construction including: economic, social, technical and environmental aspects [16]. Miyatake argued that sustainability achievement in construction industry requires a full awareness of all stakeholders regarding the change of the industry framework from linear to cyclic approach [28]. This involves the life cycle of construction materials through planning, design, construction, reuse and waste management. According to Abidin the implementation of sustainable construction applications in construction requires knowledge, consciousness and full understanding of individual actions consequences [1]. Powmya and Abidin carried out a market survey in Oman and they concluded that the transition from traditional to sustainable approach in the construction industry is a time consuming process as it requires changes in the perspectives of all stakeholders [31].

Among researchers and practitioners the economic factor is considered a critical challenge in the implementation of sustainable construction. Meryman and Silman [27], and Bon and Hutchinson [9] addressed the economic issues as a serious challenge towards the achievement of sustainability in construction, in addition to policy and technical issues. While other researchers (e.g. Porter and Van der Linde [30]; Wagner, Schaltegger, and Wehrmeyer [38]) have reported that there is a significant relationship between business competitiveness and sustainability. Therefore, rapid growing economy and urbanization could be seen as an opportunity for implementing sustainable construction rather than to be considered a burden.

Despite the significant contribution of the economic factors in the application of sustainable construction, Abidin and Powmya has identified through market survey in Oman a lack of governmental incentives [2]. Many developers show uncertainty in the performance of green technologies and limited understanding of sustainable construction

among the industry in Oman. The survey shows also a managerial concern of all stakeholders regarding the implementation of sustainable construction in Oman. With respect to the above initial research, the major challenges of sustainable construction in Oman were classified into four main groups with potential 13 challenges (See table 1).

Table 1 Classification of the major potential challenges to the sustainable construction in Oman. Adapted from Powmya ([31].

Group	Potential challenges
Economic Challenges	• C01: Additional cost • C02: Incremental time
Capacity / Professional challenges	• C03: Lack of knowledge on green technologies and materials • C04: Limited availability of green suppliers and information • C05: Lack of quantitative evaluation tools • C06: Lack of building codes and regulation • C07: Lack of professional capacity
Societal Challenges	• C08: Lack of governmental incentives • C09: Resistance to change traditional construction processes • C10: Lack of public awareness
Technological Challenges	• C11: Uncertainty in sustainable technologies performance • C12: Misunderstanding of sustainable technological operation • C13: Lack of adequate green technological specifications

3.1. Economic challenges

There is no doubt that the economic revenue of any construction project is the main objectives for investors and developers, therefore it is a critical consideration for decision makers regarding the implementation of sustainable construction practices [24]. In their market survey, Powmya and Abidin identified that among construction practitioners in Oman there is a belief that sustainable construction practices will raise the cost of construction projects without a quantifying benefits; a perception that poses an important challenge [31]. This challenge is especially evident in developing countries; and Oman as well; because energy efficient technologies such as high performance insulation protection, eater and energy saving equipment have to be imported increasing the overall project cost [23]. While most western cost analysis studies conducted on sustainable construction practices show increased cost range from 0-18% [20], the additional cost; known as "green premium" is considerable higher in Oman. In his recent field observation study, Maguina noted that the green premium in a neighbour country (U.A.E) have reached 30% in some projects [25]. The reasons for this dramatic increase were reported due to the lack of locally available equipment and green materials as well as the use of highly specialized services. Powmya and Abidin identified other challenges that will have an impact on the cost effectiveness of any construction project in Oman such as the lack of demand for green products and the lack of governmental incentives [31].

Another aspect related to economics; apart from the cost; is the construction time which is considered as a critical performance criteria of construction projects [11]. Construction delays will often increase the cost of the project and affect the reputation of all stakeholders [7]. Since sustainable construction requires the integration of green technologies with other building components [17], therefore dramatic delays will result if this is not considered throughout all project stages [19].

3.2. Capacity / Professional challenges

It has been generally recognized that one of the significant factors that hinders the capacity of different industry stakeholders to collaborate towards a common goal is the lack of well-defined sustainable construction practices [29]. Abidin identified the lack of knowledge on green technologies and materials among construction practitioners in Oman, which is considered a significant challenge to the industry for the implementation of green strategies and specifications [2]. Although the construction industry in Oman depends mainly on foreign workforce, yet from the research it was evident that there is a lack of the necessary experience or expertise required to meet the challenge among all those with responsibilities in this area.

Another challenge to the sustainable construction in Oman is the green material supply chain. According to Powmya, green materials and equipment are not available from the local supply network in Oman; therefore a reliable supply chain could not be insured [31]. This issue affects dramatically the cost effectiveness of the implementation of sustainable construction practices. Therefore, uncertainties and inadequate trust relationship will occur due to the conflict of interests among stakeholders. According to Sodagar and Fieldson the need to effective legislation is to raise the lower benchmark while market forces will raise the upper benchmark [33]. The lack of green building codes and assessment methods in Oman is another major barrier towards sustainable practices in the construction industry.

3.3. Societal challenges

Public awareness of environmental issues is an important aspect for the success of sustainable construction practices. Powmya & Abidin concluded from their market survey that although majority of clients in Oman are aware of environmental pollution issues, they often perceive that environmental protection is the sole responsibility of the local government [31]. As a result of this limited view of responsibility beside the limited awareness of the cost and benefits of sustainable construction practices, there is a resistance among different players of the construction industry to change the conventional construction methods and processes to more sustainable ones.

Al Badi, Malik, & Gastli mentioned that the lack of adequate fiscal incentives from the Omani government is another crucial barrier for the implementation of sustainable practices in the country [4]. Mahroum reported that public projects have the largest share of the construction market in Oman [26]; therefore initiatives of sustainable applications should start from the government. Since sustainable technologies and practices are not financial and economical competitive in the meanwhile, there is a need for governmental support from policies to incentives.

3.4. Technological challenges

The use of green materials and equipment are vital factor for the implementation of sustainable construction practices [32]. The limited availability of green materials and equipment in the local market is a significant challenge facing the Omani construction industry. Other important challenge is the uncertainty among industry stakeholders in the performance of these products and technologies and consequently their cost effectiveness. These challenges raise the resistance among practitioners to support the change from conventional to more sustainable construction practices.

Crawley & Aho highlighted the importance of green specifications as a crucial factor contributing to the success of sustainable construction practices [12]. The absence of formal building codes and standards in Oman is forming a crucial challenge to the industry. According to Abidin & Powmya professionals tolerate their designs based on their schooling or background leading to a wide variation of standards across Oman [2]. Sustainable technologies in Oman are still at an early stage of implementation where specifications and other contract documents have not been established properly. Al Hatmi, Tan, Al Badi, & Charabi reported the lack of fully understanding of the implementation and operation requirements of sustainable construction within the construction industry in Oman [6]. The lack of adequate sustainable technologies presents a crucial challenge for sustainable construction.

4. Case Study

4.1. Background:

A case study was conducted by Sultan Qaboos University to ascertain the critical opportunities and challenges contributing to the implementation of sustainable construction practices. The project was conducted within a competition organized by The Research Council to design, build and operates a house that is both cost effective and energy effective. The case study was an effective application to investigate the project within its real life context as

well as establishing multiple sources of evidence. The parties involved in the project were College of Engineering acting as client and designer, consultants, contractor and the Research Council as the competition regulator.

4.2. Design Phase:

According to the rules of the competition, the design of the project was assessed at two stages, namely conceptual design and design development. The conceptual design phase deals mainly with aspects related to building form, function and the reciprocal relationship with the intimate environment. These aspects includes thermal performance of the building envelope, daylight and shading system, natural ventilation, renewable energy systems (such as photovoltaic power supply), and water resources (such as water saving sanitary appliances, grey water and solid waste management system).At the end of this stage the university commissioned an environmental consultant to compare the designed house against the third party review system 'LEED for Homes' to showcase its environmental credentials. The assessment correspond the design to 'LEED Gold' and is estimated to achieve 'LEED Platinum' once the detailed construction design is confirmed. A detailed score card is shown in Figure (2) for a full review of the rating system.

The design development stage focused more on the technological aspects with respect to the structure, fabric elements, and material specifications. These aspects includes the dealing of performance, durability, and assembly issues aiming to improve the sustainability of the house through the use of green materials, reduce waste management, energy efficiency, and health and safety considerations. The design team from the College of Engineering and the design consultant shows fully understanding of the potential environmental impacts of the project as well as the way these aspects could be reflected into the design and construction phases. However, several barriers regarding the environmental and sustainability considerations were identified. The design team had no formal experience in handling environmental aspects in design. Furthermore, the design team was more familiar with the conventional design approach, which doesn't contribute much on the environmental issues. The team shows little knowledge of environmental regulations, and green materials and specifications. In addition to these issues, the limited availability of green construction materials in the local market was another burden. Some construction materials and equipment had to be imported which represented additional cost to the project, or less environmentally effectives alternatives had to be found.

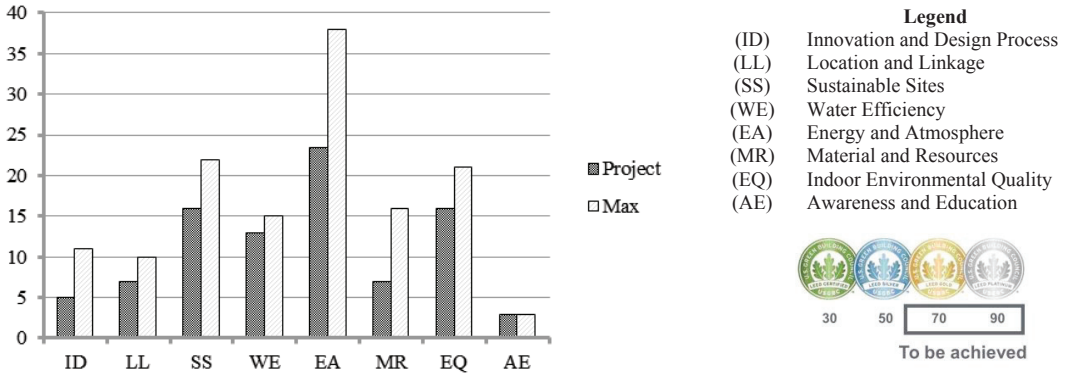

Figure 2 the proposed Eco-house design corresponds to the platinum certification level for LEED

4.3. Construction Phase:

Through an open tender procedure a construction contractor was selected. The responsibility of achieving the environmental requirements of the design team at site level rests solely on the contractor. Site supervision consultancy services were procured to assure the implementation of effective sustainable construction practices.

Similarly to the design phase, the main contractor and the supervision consultant had no formal experience with sustainable construction practices. This lack of knowledge and misunderstanding of the main goals of sustainable construction represented an additional load on the design team to bridge the gap. Sustainable construction practices are considered by the contractor as unpractical processes leading to extra costs and resources, therefore there was a great resistance to change the traditional construction processes. Furthermore, the poor communications between all parties lead to additional costs and delays to the project.

Another barrier to the sustainable construction implementation was the imperfect specifications which lead to enormous variation orders and additional costs. This could have been avoided if the design team contacts the manufacturers during the design phase. Manufacturers and suppliers contributed effectively on the sustainability of the project as they showed more knowledge and experience; through their international connections; on sustainable construction practices.

5. Conclusion

Sustainable construction practices are still at an early stage in Oman. However, the implementation of these practices could contribute to the country's development through reducing resources consumption; such as energy and water; and environment protection. Many opportunities for sustainable construction in Oman have been identified. Limitation of oil production may force the government to invest more on renewable energy sources. In addition to reducing environmental side effects, following sustainable construction practices can also lower both development and operational costs. This could be a significant advantage to the country's efforts to provide sufficient affordable housing across the sultanate and contribute to the governmental desire to convert Oman into a more appealing tourist destination. Since local government in Oman is the largest investor in the construction market, producing sustainability legislation and strategies suited to its needs will ensure profitability.

Through a comprehensive review of studies and a case study, this paper has identified the most significant challenges associated with the implementation of sustainable construction practices in Oman. These critical challenges includes cost effectiveness, project delays, limited availability of green materials and equipment, lack of knowledge and awareness, and the lack of environmental legislation. Actions have been initiated by the government through the Research Council but more support and incentives are required.

The case study was conducted under the rules of Sultan Qaboos University which is a public organization; therefore some limitations are associated with the tendering and procurement procedures. Further research opportunities involve the validation of different stakeholder's knowledge and willingness to implement these practices in Oman.

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